PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-205461
(43)Date of publication of application : 05.08.1997

(51)Int.Cl. H04L 12/56
H04L 12/46
H04L 12/28
H04L 29/06
H04Q 3/00

(21)Application number : 08-034300
(22)Date of filing : 29.01.1996

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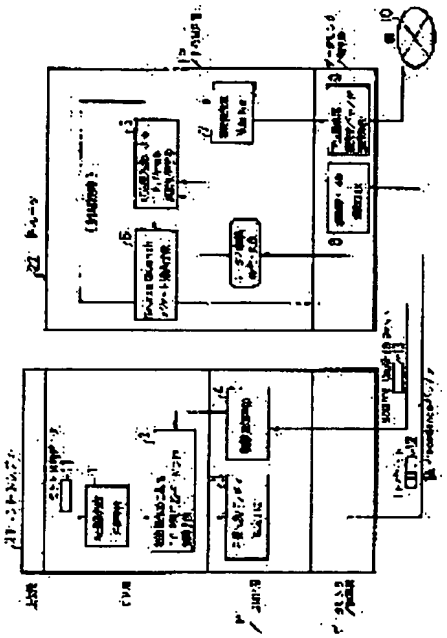
(54) PRIORITY CONTROL SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To perform priority control of data transfer corresponding to traffic characteristics by high-order application kinds for congestion inside an IP (internet protocol) router or network congestion.
SOLUTION: A transfer priority decision means 1 decides transfer priority corresponding to the traffic characteristics of data from a high-order layer and an IP priority parameter setting means 3 maps the transfer priority to a precedence parameter 14 and sends out an IP packet 12 to the IP router 22. An IP packet abandonment control means 5 by the transfer priority checks the precedence parameter 14 and controls the abandonment of the IP packet 12 of low transfer priority and a Source Quench packet send-out means 6 informs the end system 21 of a transmission origin of the abandonment generation of the IP packet 12 by a Souce Quench packet 13. A TCP user data flow control means 2 by the transfer priority controls the transmission suppression of the TCP user data 11 of the low transfer priority.



LEGAL STATUS

[Date of request for examination] 29.01.1996
[Date of sending the examiner's decision of rejection] 01.09.1999
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision

of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

JAPANESE [JP,09-205461,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the end system connected to LAN of a TCP/IP network A transfer priority decision means to determine a transfer priority according to the traffic property of the data from the upper layer in a TCP layer, An IP priority parameter setting means to map the transfer priority determined by this transfer priority decision means in the Precedence parameter of the "TYPEOF SERVICE" field of IP layer, and to send out an IP packet to an IP router, Source from said IP router A notice means of congestion to notify abandonment generating of the IP packet by the congestion at the time of junction to a TCP layer from IP / ICMP layer at the time of reception of a Quench packet, It has a TCP user data flow control means by the transfer priority which controls transmitting suppression of a TCP user data with a low transfer priority by the TCP layer based on the measurement value of the count of the notice of congestion from an IP/ICMP layer. In the IP router of a TCP/IP network The IP packet abandonment control means by the transfer priority which checks the Precedence parameter of the IP packet which received in the IP/ICMP layer, and controls abandonment of an IP packet with a low transfer priority at the time of congestion generating in an IP router, or recovery detection, It is Source about abandonment generating of the IP packet by the congestion at the time of the junction by the IP packet abandonment control means by this transfer priority. By the Quench packet Source notified to the end system of a transmitting agency Priority-control method characterized by having a Quench packet sending-out means.
[Claim 2] When said IP router is connected to the network which has a notice function of congestion The network congestion and a notice means of recovery to notify network congestion generating or recovery to an IP/ICMP layer based on the notice detection of hard flow congestion from said network below by the data link layer of said IP router, It is said Source about the IP packet discarded by the IP packet abandonment control means by said transfer priority. With a Quench packet sending-out means Source The abandonment priority allocation means which assigns the abandonment priority according to a transfer priority to the IP packet relayed after adding to a Quench packet and notifying to the end system of a transmitting agency, A priority-control method including a lower layer abandonment priority parameter setting means to map the abandonment priority assigned by this abandonment priority allocation means in the abandonment priority parameter of the protocol header below a data link layer according to claim 1.
[Claim 3] When said network is a Frame Relay network, said abandonment priority allocation means is Delete of a data link layer about an abandonment priority. It is set as a Priority service parameter and said lower layer abandonment priority parameter setting means is Delete of said data link layer. Priority-control method according to claim 2 which maps a Priority service parameter in DE bit of DL core header.
[Claim 4] When said network is an ATM network, said abandonment priority allocation means is Delete of a data link layer about an abandonment priority. It is set as a Priority service parameter and said lower layer abandonment priority parameter setting means is Delete of said data link layer. Priority-control method according to claim 2 which maps a Priority service parameter in the CLP bit of an ATM cel header.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the priority-control method in TCP (Transmission Control Protocol) / IP (Internet Protocol) network about a priority-control method.
[0002]
[Description of the Prior Art] Conventionally, in the TCP/IP network, determining a transfer priority by classification (traffic property) of a TCP user data is not performed in a TCP layer. On the other hand, as a parameter which sets the transfer priority of IP datagram to IP layer Although the Precedence parameter of the "TYPE OF SERVICE" field is specified For example, (Douglas Comer work / Jun Murai and a Hiroyuki Kusumoto translation ("the network construction-principle and protocol architecture" by TCP/IP), the 56th page, KYORITSU SHUPPAN Co., Ltd., the July, 1990 issue, reference), Since mapping with a Precedence parameter and the service parameter of IP layer was not specified, it was not used in a conventional end system and a conventional IP router.
[0003] Moreover, since mapping with the abandonment priority parameter of the frame or cel defined as the Frame Relay DL (Data Link) core layer and the ATM (Asynchronous Transfer Mode) layer and a Precedence parameter was not specified, either, it was not used in a conventional end system and a conventional IP router.
[0004]
[Problem(s) to be Solved by the Invention] In the Prior art mentioned above, since the Precedence parameter and the abandonment priority parameter were not used, the trouble that the priority control of data transfer according to the traffic property by high order application classification will not be able to perform an IP router, but it will discard IP datagram regardless of a traffic property at the time of the congestion in an IP router or network congestion generating had occurred.
[0005] Moreover, also in an end system, there was a trouble that a transmission control could not be performed based on the data transfer priority according to a traffic property at the time of the above-mentioned congestion generating.
[0006] For the above-mentioned trouble, the effect on an IP router or the high order application by the congestion in a network and the situation where the smooth communication link of the multimedia information to which especially two or more traffic properties are intermingled was unrealizable had occurred.
[0007] The purpose of this invention is in a TCP/IP network to offer the priority-control method which makes possible the priority control of data transfer according to the traffic property by high order application classification to the congestion in an IP router or network congestion, especially the congestion of a Frame Relay network or an ATM network.
[0008]
[Means for Solving the Problem] In the end system by which the priority-control method of this invention was connected to LAN of a TCP/IP network A transfer priority decision means to determine a transfer priority according to the traffic property of the data from the upper layer in

a TCP layer, An IP priority parameter setting means to map the transfer priority determined by this transfer priority decision means in the Precedence parameter of the "TYPE OF SERVICE" field of IP layer, and to send out an IP packet to an IP router, A notice means of congestion to notify abandonment generating of the IP packet by the congestion at the time of junction to a TCP layer from IP / ICMP layer at the time of reception of the SourceQuench packet from said IP router, It has a TCP user data flow control means by the transfer priority which controls transmitting suppression of a TCP user data with a low transfer priority by the TCP layer based on the measurement value of the count of the notice of congestion from an IP/ICMP layer. In the IP router of a TCP/IP network The IP packet abandonment control means by the transfer priority which checks the Precedence parameter of the IP packet which received in the IP/ICMP layer, and controls abandonment of an IP packet with a low transfer priority at the time of congestion generating in an IP router, or recovery detection, It is Source about abandonment generating of the IP packet by the congestion at the time of the junction by the IP packet abandonment control means by this transfer priority. Source notified to the end system of a transmitting agency by the Quench packet It is characterized by having a Quench packet sending-out means.

[0009] Furthermore, when said IP router is connected to the network which has a notice function of congestion, the priority-control method of this invention The network congestion and a notice means of recovery to notify network congestion generating or recovery to an IP/ICMP layer based on the notice detection of hard flow congestion from said network below by the data link layer of said IP router, It is said Source about the IP packet discarded by the IP packet abandonment control means by said transfer priority. With a Quench packet sending-out means Source The abandonment priority allocation means which assigns the abandonment priority according to a transfer priority to the IP packet relayed after adding to a Quench packet and notifying to the end system of a transmitting agency, A lower layer abandonment priority parameter setting means to map the abandonment priority assigned by this abandonment priority allocation means in the abandonment priority parameter of the protocol header below a data link layer is included.

[0010]

[Embodiment of the Invention] Next, it explains to a detail, referring to a drawing about this invention.

[0011]

[Example] Drawing 2 is the conceptual diagram of the network where the priority-control method concerning one example of this invention is contained. In drawing 2 , the end system 21 is held in LAN (Local Area Network)20 which is a TCP/IP network, and communicates with the end system 21 held in LAN20 which is the TCP/IP network of RIMOTO via IP router 22 and a network 10.

[0012] The protocol depending on LAN20 is carried in a DEKU link layer from the physical layer of an end system 21, and the TCP/IP protocol is further carried in the upper layer.

[0013] IP router 22 holds LAN20 and is ****(ed) by the network 10. IP router 22 has the function (IP routing function) in which the IP address relays an IP packet, and the data link layer carries the protocol according to UNI (a user and network interface) with a network 10 from the physical layer. In drawing 2 , since a network 10 is a Frame Relay network or an ATM network, IP router 22 has DL core layer (when a network 10 is a Frame Relay network) or an ATM layer (when a network 10 is an ATM network).

[0014] Drawing 1 is the block diagram showing the configuration of the priority-control method concerning one example of this invention. As for the priority-control method of this example, the principal part consists of a network 10, an end system 21, and IP router 22.

[0015] The transfer priority decision means 1 and the TCP user data flow control means 2 by the transfer priority are included in the TCP layer of an end system 21.

[0016] The transfer priority decision means 1 determines a transfer priority with the traffic property of the TCP user data 11 from the upper layer.

[0017] The TCP user data flow control means 2 by the transfer priority controls transmitting suppression of the TCP user data 11 with a low transfer priority based on the measurement

value of the count of the notice of congestion from an IP/ICMP (Internet Control Message Protocol) layer.
[0018] IP priority parameter setting means 3 and the notice means 4 of congestion are included in the IP/ICMP layer of an end system 21.
[0019] IP priority parameter setting means 3 maps the transfer priority determined in the TCP layer in the Precedence parameter 14 of the "TYPE OF SERVICE" field of IP layer, and sends out IP packet 12 to IP router 22.
[0020] The notice means 4 of congestion is Source from IP router 22. At the time of reception of the Quench packet 13, abandonment generating of IP packet 12 by the congestion at the time of junction is notified to a TCP layer from the IP/ICMP layer of an end system 21.
[0021] The IP packet abandonment control means 5 according to a transfer priority in the IP/ICMP layer of IP router 22, and Source The Quench packet sending-out means 6 and the abandonment priority allocation means 7 are included.
[0022] When the notice from the network congestion and the notice means 8 of recovery included in the time of congestion generating in IP router / recovery detection, or a data link/physical layer is received, the IP packet abandonment control means 5 by the transfer priority checks the Precedence parameter 14 of IP packet 12 which received, and controls abandonment of IP packet 12 with a low priority.
[0023] Source The Quench packet sending-out means 6 is Source about IP packet 12 discarded in the IP packet abandonment control means 5 by the transfer priority. It puts on the Quench packet 13 and congestion generating is notified to the end system 21 of a transmitting agency.
[0024] The abandonment priority allocation means 7 is Source at the time of network congestion. According to a transfer priority, an abandonment priority is assigned to IP packet 12 to relay after sending out the Quench packet 13.
[0025] Network congestion and the notice means 8 of recovery, and the lower layer abandonment priority parameter setting means 9 are included in the data link/physical layer of IP router 22. For example, when each above-mentioned means is included in DL core layer when the network 10 to which IP router 22 is connected is a Frame Relay network, and IP router 22 is connected to the ATM network, each above-mentioned means is included in an ATM layer.
[0026] Network congestion and the notice means 8 of recovery notify network congestion generating or recovery to IP layer based on the notice detection of hard flow congestion from a network 10.
[0027] The lower layer abandonment priority parameter setting means 9 maps the abandonment priority assigned by the abandonment priority allocation means 7 of an IP/ICMP layer in the abandonment priority parameter of the protocol header below a data link layer. Specifically, an abandonment priority parameter is equivalent to DE (abandonment is possible) bit of DL core header of a Frame Relay, or the CLP (cel abandonment priority) bit of an ATM cel header.
[0028] Drawing 3 is a control flow chart in an end system 21, and, for (a), (b) is Source about the processing at the time of data transmission. The processing at the time of reception of the Quench packet 13 is shown, respectively. If drawing 3 (a) is referred to, the processing at the time of data transmission will consist of the transfer priority decision step 31, a Prioity service parameter setting step 32, and a Precendence parameter mapping step 33. It is Source when drawing 3 (b) is referred to. The processing at the time of reception of the Quench packet 13 consists of the notice step 34 of IP packet abandonment, the TCP user-data transmitting suppression step 35, the count measurement step 36 of the notice of congestion, a transfer priority upper-limit rise step 37, and a transfer priority upper-limit downward step 38.
[0029] Drawing 4 is a control flow chart in IP router 22, (a) shows the processing at the time of congestion generating in an IP router, and (b) shows the processing at the time of network congestion generating, respectively. If drawing 4 (a) is referred to, the processing at the time of congestion generating in an IP router will consist of the congestion continuation timer starting step 41, the IP packet abandonment step 42, the abandonment IP packet transmitting former notice step 43, an abandonment IP packet transfer priority upper-limit rise step 44, and an abandonment IP packet transfer priority upper-limit downward step 45. When drawing 4 (b) is referred to, the processing at the time of network congestion generating The notice step 51 of

hard flow congestion, and the congestion continuation timer starting step 52, The IP packet abandonment step 53 and the abandonment IP packet transmitting former notice step 54, The transfer IP packet abandonment priority allocation step 55 and Delete Priority parameter setting step 56, Delete It consists of the Priority parameter mapping step 57, the abandonment IP packet transfer priority upper-limit rise step 58, a notice step 59 of network congestion recovery, and an abandonment IP packet transfer priority upper-limit downward step 60.

[0030] Next, actuation of the priority-control method of this example constituted in this way is explained.

[0031] When the end system 21 connected to LAN20 which is a TCP/IP network transmits data, the TCP layer of an end system 21 determines the transfer priority which corresponds out of the transfer priority of 8 level with the transfer priority decision means 1 according to the traffic property of the TCP user data 11 passed from the upper layer. That is, from a TCP port number, the classification of the TCP user data 11 is identified, and a transfer priority is determined from the correspondence table of the user-data classification (traffic property) and the transfer priority which are beforehand defined as the end system 21. The integer of 0-7 defines a transfer priority, a priority of 0 is the lowest and 7 presupposes that a priority is the highest. For example, data delivery nature like SMTP (E-mail) assigns a low priority (0-3) to the traffic seldom demanded, a higher priority (4-6) is assigned to the bulk transfer traffic as which data delivery nature like FTP (file transfer) or NFS (Network File System) is required, and 7 is assigned to network control traffic still like SNMP (network administration) whenever [of the highest priority] (step 31). The value of the determined transfer priority is set as the Priority service parameter of IP layer. A Priority service parameter is the service interface of IP layer which this invention defined newly (step 32).

[0032] Next, IP layer of an end system 21 maps the Priority service parameter of IP layer in the Precedence parameter of the "TYPE OFSERVICE" field of IP header with IP priority parameter setting means 3. The Precedence parameter is defined from the former as a parameter which sets up the transfer priority of IP datagram, consists of triplets and can define the priority of 8 level. The value 0 of a priority is the lowest and the value 7 is prescribed that a priority is the highest (step 33). IP packet 12 is sent out to IP router 22.

[0033] IP router 22 relays IP packet 12 which received from LAN20 to IP router 22 of the destination via a network 10. When the congestion in IP router 22 is detected, by the IP packet abandonment control means 5 by the transfer priority, IP layer of IP router 22 starts a congestion continuation timer (not shown) (step 41), checks the Precedence parameter of IP packet 12, and discards IP packet 12 with a low transfer priority. For example, a Precedence parameter value discards IP packet 12 of 0-2 (step 42).

[0034] Furthermore, IP / ICMP layer of IP router 22 are Source. By the Quench packet sending-out means 6, it is Source. By transmitting towards the end system 21 of a transmitting agency with [which discarded the Quench packet 13] IP packet 12, abandonment generating of IP packet 12 by the congestion at the time of junction is notified to the end system 21 of a transmitting agency (step 43).

[0035] When a congestion continuation timer carries out a time-out, IP layer of IP router 22 discards an IP packet with a still higher transfer priority by the IP packet abandonment control means 5 by the transfer priority. Thus, whenever a congestion continuation timer carries out a time-out, the upper limit of the transfer priority of IP packet 12 to discard is raised (step 44).

[0036] On the other hand, when IP layer of IP router 22 detects the congestion recovery in IP router 22 before the congestion continuation timer carried out the time-out, IP layer of IP router 22 lowers gradually the upper limit of the transfer priority of IP packet 12 discarded according to a slow start mechanism by the IP packet abandonment control means 5 by the transfer priority (step 45).

[0037] The end system 21 of a transmitting agency is Source from IP router 22. If the Quench packet 13 is received, the IP/ICMP layer of an end system 21 will notify that abandonment of IP packet 12 occurred at the time of junction to the TCP layer of an end system 21 by the congestion in an IP router with the notice means 4 of congestion (step 34).

[0038] The TCP layer of an end system 21 controls transmission of the TCP user data 11 with a

low transfer priority with the TCP user data flow control means 2 by the transfer priority. For example, a transfer priority once stops transmission of the TCP user data 11 of 0-2 (step 35). Next, the count of the notice of congestion from IP layer is measured between the measuring times T (step 36). When larger than the set point with the measurement value, a TCP layer also inhibits transmission of the TCP user data 11 with a still higher transfer priority with the TCP user data flow control means 2 by the transfer priority.

[0039] As long as the above-mentioned measurement value is larger than the above-mentioned set point, the TCP layer of an end system 21 also inhibits transmission of the TCP user data 11 with a still higher transfer priority with the TCP user data flow control means 2 by the transfer priority. Thus, the upper limit of the transfer priority of the TCP user data 11 which inhibits transmission is raised to every time amount T (step 37).

[0040] On the other hand, when the count of the notice of congestion between the measuring times T becomes below the above-mentioned set point, the TCP layer of an end system 21 lowers gradually the upper limit of the transfer priority of the TCP user data 11 which inhibits transmission to every time amount T according to the slow start mechanism with the TCP user data flow control means 2 by the transfer priority (step 38).

[0041] If congestion occurs with a network 10 when IP router 22 is connected to the network 10 which has a notice function of congestion, DL core layer (when a network 10 is a Frame Relay network) of IP router 22 of **** or an ATM layer will notify network congestion generating to a network 10 with network congestion and the notice means 8 of recovery at IP / ICMP layer based on the notice detection of hard flow congestion from a network 10 (step 51). (when a network 10 is an ATM network)

[0042] By the IP packet abandonment control means 5 by the transfer priority, the IP/ICMP layer of IP router 22 starts a congestion continuation timer (step 52), checks the Precedence parameter of IP packet 12 under junction processing, and discards IP packet 12 with a low transfer priority. For example, a Precedence parameter value discards IP packet 12 of 0-2 (step 53). Furthermore, an IP/ICMP layer is Source. By the Quench packet sending-out means 6, it is Source. It transmits towards the end system 21 of a transmitting agency with [which discarded the Quench packet 13] IP packet 12 (step 54).

[0043] On the other hand, it is Source. After transmitting to the end system 21 of the transmitting origin of the Quench packet 13, the IP/ICMP layer of IP router 22 assigns the abandonment priority of 2 level according to a transfer priority further to IP packet 12 to relay with the abandonment priority allocation means 7. For example, a Precedence parameter value assigns the abandonment priority 1 to IP packet 12 of 3-5, and a Precedence parameter value assigns the abandonment priority 0 to IP packet 12 of 6 and 7 (step 55).

[0044] The IP/ICMP layer of IP router 22 is Delete of a data link layer about the above-mentioned abandonment priority. It is set as a Priority service parameter. Delete A Priority service parameter is the service interface of the data link layer which this invention defined newly (step 56).

[0045] Next, IP router 22 maps the assigned abandonment priority in the abandonment priority parameter of the protocol header below a data link layer. When a network 10 is a Frame Relay network, DL core layer of IP router 22 is Delete by the lower layer abandonment priority parameter setting means 9. A Priority service parameter is mapped in DE (abandonment is possible) bit of DL core header. Namely, Delete Priority service parameter = in the case of 1, it is referred to as DE bit =ON, and is Delete. Priority service parameter = in the case of 0, it is referred to as DE bit =OFF. DE bit = the frame of ON is preferentially discarded with a network 10 at the time of congestion generating in a network 10 (step 57).

[0046] Moreover, when a network 10 is an ATM network, the ATM layer of IP router 22 is Delete by the lower layer abandonment priority parameter setting means 9. A Priority service parameter is mapped in the CLP (cel abandonment priority) bit of an ATM cel header. Namely, Delete Priority service parameter = in the case of 1, it is referred to as CLP bit =ON, and is Delete. Priority service parameter = in the case of 0, it is referred to as CLP bit =OFF. CLP bit = the frame of ON is preferentially discarded with a network 10 at the time of congestion generating in a network 10 (step 57).

[0047] When a congestion continuation timer carries out a time-out, the IP/ICMP layer of IP router 22 discards IP packet 12 with a still higher transfer priority by the IP packet abandonment control means 5 by the transfer priority. Thus, whenever a congestion continuation timer carries out a time-out, the transfer priority of an abandonment upper limit is raised (step 58).
[0048] On the other hand, when IP / ICMP layer receives the notice of network congestion recovery from DL core layer or an ATM layer before the congestion continuation timer carried out the time-out (step 59), IP / ICMP layer of IP router 22 lower gradually the upper limit of the transfer priority of IP packet 12 discarded according to a slow start mechanism by the IP packet abandonment control means 5 by the transfer priority (step 60).
[0049] Thus, in the above-mentioned example, in an end system 21, a TCP layer determines a transfer priority with the traffic property of the data from the upper layer, and maps the determined transfer priority in the transfer priority parameter of IP layer. For this reason, in a TCP/IP network, an end system 21 becomes possible [setting the transfer priority according to a traffic property as each IP packet 12 to send out].
[0050] Moreover, IP router 22 checks the transfer priority parameter of IP packet 12 which receives congestion generating in an IP router and recovery, or the notice of network congestion at the time of detection, and controls abandonment of IP packet 12 with a low transfer priority. Moreover, the transfer priority of IP packet 12 is mapped in the abandonment priority parameter of the protocol header below a data link layer. For this reason, IP router 22 becomes possible [performing the priority control of data transfer according to the traffic property of high order application] to the congestion in an IP router, or the notice of network congestion.
[0051] Furthermore, IP router 22 is Source about abandonment generating of IP packet 12 by congestion. The Quench packet 13 notifies to the end system 21 of a transmitting agency, and an end system 21 controls transmitting suppression of the TCP user data 11 with a low transfer priority based on the measurement value of the count of the notice of congestion. This becomes possible also in an end system 21 to perform a transmission control based on the data transfer priority according to a traffic property to congestion.
[0052]
[Effect of the Invention] As explained above, according to this invention, it sets to a TCP/IP network. A transfer priority decision means and IP priority parameter setting means are formed in an end system. According to the traffic property of the data from the upper layer, a transfer priority is determined in a TCP layer. By mapping the determined transfer priority in the Precedence parameter of the "TYPE OF SERVICE" field of IP layer, and having sent out the IP packet to the IP router It is effective in becoming possible to set the transfer priority according to a traffic property as each IP packet to send out.
[0053] Moreover, an IP packet abandonment control means and Source according to a transfer priority to an IP router A Quench packet sending-out means The notice means of congestion and the TCP user data flow control means by the transfer priority are formed in an end system. Check the Precedence parameter of the IP packet which received at the time of congestion generating in an IP router, or recovery detection, and abandonment of an IP packet with a low transfer priority is controlled. It is Source about abandonment generating of the IP packet by the congestion at the time of junction. A Quench packet notifies to the end system of a transmitting agency. Source from an IP router Abandonment generating of the IP packet by the congestion at the time of junction is notified to a TCP layer from IP / ICMP layer at the time of reception of a Quench packet. By having controlled transmitting suppression of a TCP user data with a low transfer priority by the TCP layer based on the measurement value of the count of the notice of congestion from an IP/ICMP layer It is effective in becoming possible to perform the priority control of data transfer according to the traffic property of high order application to the congestion in an IP router.
[0054] Furthermore, when the IP router is connected to the network which has a notice function of congestion Network congestion and the notice means of recovery, an abandonment priority allocation means, and a lower layer abandonment priority parameter setting means are formed in an IP router. Based on the notice detection of hard flow congestion from a network, network congestion generating or recovery is notified to an IP/ICMP layer below by the data link layer. It

is Source about the discarded IP packet. The abandonment priority according to a transfer priority is assigned to the IP packet relayed after adding to a Quench packet and notifying to the end system of a transmitting agency. By having mapped the assigned abandonment priority in the abandonment priority parameter of the protocol header below a data link layer It is effective in becoming possible to perform a transmission control based on the data transfer priority according to a traffic property to network congestion, especially the congestion of a Frame Relay network or an ATM network.

[0055] Thus, it becomes possible to lessen effect on the high order application by the congestion in an IP router or a network. Furthermore, it becomes possible to realize the smooth communication link of the multimedia information to which two or more traffic properties are intermingled.

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TECHNICAL FIELD

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PRIOR ART

[Description of the Prior Art] Conventionally, in the TCP/IP network, determining a transfer priority by classification (traffic property) of a TCP user data is not performed in a TCP layer. On the other hand, as a parameter which sets the transfer priority of IP datagram to IP layer Although the Precedence parameter of the "TYPE OF SERVICE" field is specified For example, (Douglas Comer work / Jun Murai and a Hiroyuki Kusumoto translation ("the network construction-principle and protocol architecture" by TCP/IP), the 56th page, KYORITSU SHUPPAN Co., Ltd., the July, 1990 issue, reference), Since mapping with a Precedence parameter and the service parameter of IP layer was not specified, it was not used in a conventional end system and a conventional IP router.
[0003] Moreover, since mapping with the abandonment priority parameter of the frame or cel defined as the Frame Relay DL (Data Link) core layer and the ATM (Asynchronous Transfer Mode) layer and a Precedence parameter was not specified, either, it was not used in a conventional end system and a conventional IP router.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, it sets to a TCP/IP network. A transfer priority decision means and IP priority parameter setting means are formed in an end system. According to the traffic property of the data from the upper layer, a transfer priority is determined in a TCP layer. By mapping the determined transfer priority in the Precedence parameter of the "TYPE OF SERVICE" field of IP layer, and having sent out the IP packet to the IP router It is effective in becoming possible to set the transfer priority according to a traffic property as each IP packet to send out.
[0053] Moreover, an IP packet abandonment control means and Source according to a transfer priority to an IP router A Quench packet sending-out means The notice means of congestion and the TCP user data flow control means by the transfer priority are formed in an end system. Check the Precedence parameter of the IP packet which received at the time of congestion generating in an IP router, or recovery detection, and abandonment of an IP packet with a low transfer priority is controlled. It is Source about abandonment generating of the IP packet by the congestion at the time of junction. A Quench packet notifies to the end system of a transmitting agency. Source from an IP router Abandonment generating of the IP packet by the congestion at the time of junction is notified to a TCP layer from IP / ICMP layer at the time of reception of a Quench packet. By having controlled transmitting suppression of a TCP user data with a low transfer priority by the TCP layer based on the measurement value of the count of the notice of congestion from an IP/ICMP layer It is effective in becoming possible to perform the priority control of data transfer according to the traffic property of high order application to the congestion in an IP router.
[0054] Furthermore, when the IP router is connected to the network which has a notice function of congestion Network congestion and the notice means of recovery, an abandonment priority allocation means, and a lower layer abandonment priority parameter setting means are formed in an IP router. Based on the notice detection of hard flow congestion from a network, network congestion generating or recovery is notified to an IP/ICMP layer below by the data link layer. It is Source about the discarded IP packet. The abandonment priority according to a transfer priority is assigned to the IP packet relayed after adding to a Quench packet and notifying to the end system of a transmitting agency. By having mapped the assigned abandonment priority in the abandonment priority parameter of the protocol header below a data link layer It is effective in becoming possible to perform a transmission control based on the data transfer priority according to a traffic property to network congestion, especially the congestion of a Frame Relay network or an ATM network.
[0055] Thus, it becomes possible to lessen effect on the high order application by the congestion in an IP router or a network. Furthermore, it becomes possible to realize the smooth communication link of the multimedia information to which two or more traffic properties are intermingled.

[Translation done.]

* NOTICES *

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In the Prior art mentioned above, since the Precedence parameter and the abandonment priority parameter were not used, the trouble that the priority control of data transfer according to the traffic property by high order application classification will not be able to perform an IP router, but it will discard IP datagram regardless of a traffic property at the time of the congestion in an IP router or network congestion generating had occurred.
[0005] Moreover, also in an end system, there was a trouble that a transmission control could not be performed based on the data transfer priority according to a traffic property at the time of the above-mentioned congestion generating.
[0006] For the above-mentioned trouble, the effect on an IP router or the high order application by the congestion in a network and the situation where the smooth communication link of the multimedia information to which especially two or more traffic properties are intermingled was unrealizable had occurred.
[0007] The purpose of this invention is in a TCP/IP network to offer the priority-control method which makes possible the priority control of data transfer according to the traffic property by high order application classification to the congestion in an IP router or network congestion, especially the congestion of a Frame Relay network or an ATM network.

[Translation done.]

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MEANS

[Means for Solving the Problem] In the end system by which the priority-control method of this invention was connected to LAN of a TCP/IP network A transfer priority decision means to determine a transfer priority according to the traffic property of the data from the upper layer in a TCP layer, An IP priority parameter setting means to map the transfer priority determined by this transfer priority decision means in the Precedence parameter of the "TYPE OF SERVICE" field of IP layer, and to send out an IP packet to an IP router, A notice means of congestion to notify abandonment generating of the IP packet by the congestion at the time of junction to a TCP layer from IP / ICMP layer at the time of reception of the SourceQuench packet from said IP router, It has a TCP user data flow control means by the transfer priority which controls transmitting suppression of a TCP user data with a low transfer priority by the TCP layer based on the measurement value of the count of the notice of congestion from an IP/ICMP layer. In the IP router of a TCP/IP network The IP packet abandonment control means by the transfer priority which checks the Precedence parameter of the IP packet which received in IP / ICMP layer, and controls abandonment of an IP packet with a low transfer priority at the time of congestion generating in an IP router, or recovery detection, It is Source about abandonment generating of the IP packet by the congestion at the time of the junction by the IP packet abandonment control means by this transfer priority. Source notified to the end system of a transmitting agency by the Quench packet It is characterized by having a Quench packet sending-out means.
[0009] Furthermore, when said IP router is connected to the network which has a notice function of congestion, the priority-control method of this invention The network congestion and a notice means of recovery to notify network congestion generating or recovery to an IP/ICMP layer based on the notice detection of hard flow congestion from said network below by the data link layer of said IP router, It is said Source about the IP packet discarded by the IP packet abandonment control means by said transfer priority. With a Quench packet sending-out means Source The abandonment priority allocation means which assigns the abandonment priority according to a transfer priority to the IP packet relayed after adding to a Quench packet and notifying to the end system of a transmitting agency, A lower layer abandonment priority parameter setting means to map the abandonment priority assigned by this abandonment priority allocation means in the abandonment priority parameter of the protocol header below a data link layer is included.
[0010]
[Embodiment of the Invention] Next, it explains to a detail, referring to a drawing about this invention.

[Translation done.]

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EXAMPLE

[Example] Drawing 2 is the conceptual diagram of the network where the priority-control method concerning one example of this invention is contained. In drawing 2 , the end system 21 is held in LAN (Local Area Network)20 which is a TCP/IP network, and communicates with the end system 21 held in LAN20 which is the TCP/IP network of RIMOTO via IP router 22 and a network 10.
[0012] The protocol depending on LAN20 is carried in a DEKU link layer from the physical layer of an end system 21, and the TCP/IP protocol is further carried in the upper layer.
[0013] IP router 22 holds LAN20 and is ****(ed) by the network 10. IP router 22 has the function (IP routing function) in which the IP address relays an IP packet, and the data link layer carries the protocol according to UNI (a user and network interface) with a network 10 from the physical layer. In drawing 2 , since a network 10 is a Frame Relay network or an ATM network, IP router 22 has DL core layer (when a network 10 is a Frame Relay network) or an ATM layer (when a network 10 is an ATM network).
[0014] Drawing 1 is the block diagram showing the configuration of the priority-control method concerning one example of this invention. As for the priority-control method of this example, the principal part consists of a network 10, an end system 21, and IP router 22.
[0015] The transfer priority decision means 1 and the TCP user data flow control means 2 by the transfer priority are included in the TCP layer of an end system 21.
[0016] The transfer priority decision means 1 determines a transfer priority with the traffic property of the TCP user data 11 from the upper layer.
[0017] The TCP user data flow control means 2 by the transfer priority controls transmitting suppression of the TCP user data 11 with a low transfer priority based on the measurement value of the count of the notice of congestion from an IP/ICMP (Internet Control Message Protocol) layer.
[0018] IP priority parameter setting means 3 and the notice means 4 of congestion are included in the IP/ICMP layer of an end system 21.
[0019] IP priority parameter setting means 3 maps the transfer priority determined in the TCP layer in the Precedence parameter 14 of the "TYPE OF SERVICE" field of IP layer, and sends out IP packet 12 to IP router 22.
[0020] The notice means 4 of congestion is Source from IP router 22. At the time of reception of the Quench packet 13, abandonment generating of IP packet 12 by the congestion at the time of junction is notified to a TCP layer from the IP/ICMP layer of an end system 21.
[0021] The IP packet abandonment control means 5 according to a transfer priority in the IP/ICMP layer of IP router 22, and Source The Quench packet sending-out means 6 and the abandonment priority allocation means 7 are included.
[0022] When the notice from the network congestion and the notice means 8 of recovery included in the time of congestion generating in IP router / recovery detection, or a data link/physical layer is received, the IP packet abandonment control means 5 by the transfer priority checks the Precedence parameter 14 of IP packet 12 which received, and controls abandonment of IP packet 12 with a low priority.
[0023] Source The Quench packet sending-out means 6 is Source about IP packet 12 discarded

in the IP packet abandonment control means 5 by the transfer priority. It puts on the Quench packet 13 and congestion generating is notified to the end system 21 of a transmitting agency.
[0024] The abandonment priority allocation means 7 is Source at the time of network congestion. According to a transfer priority, an abandonment priority is assigned to IP packet 12 to relay after sending out the Quench packet 13.
[0025] Network congestion and the notice means 8 of recovery, and the lower layer abandonment priority parameter setting means 9 are included in the data link/physical layer of IP router 22. For example, when each above-mentioned means is included in DL core layer when the network 10 to which IP router 22 is connected is a Frame Relay network, and IP router 22 is connected to the ATM network, each above-mentioned means is included in an ATM layer.
[0026] Network congestion and the notice means 8 of recovery notify network congestion generating or recovery to IP layer based on the notice detection of hard flow congestion from a network 10.
[0027] The lower layer abandonment priority parameter setting means 9 maps the abandonment priority assigned by the abandonment priority allocation means 7 of an IP/ICMP layer in the abandonment priority parameter of the protocol header below a data link layer. Specifically, an abandonment priority parameter is equivalent to DE (abandonment is possible) bit of DL core header of a Frame Relay, or the CLP (cel abandonment priority) bit of an ATM cel header.
[0028] Drawing 3 is a control flow chart in an end system 21, and, for (a), (b) is Source about the processing at the time of data transmission. The processing at the time of reception of the Quench packet 13 is shown, respectively. If drawing 3 (a) is referred to, the processing at the time of data transmission will consist of the transfer priority decision step 31, a Prioity service parameter setting step 32, and a Precendence parameter mapping step 33. It is Source when drawing 3 (b) is referred to. The processing at the time of reception of the Quench packet 13 consists of the notice step 34 of IP packet abandonment, the TCP user-data transmitting suppression step 35, the count measurement step 36 of the notice of congestion, a transfer priority upper-limit rise step 37, and a transfer priority upper-limit downward step 38.
[0029] Drawing 4 is a control flow chart in IP router 22, (a) shows the processing at the time of congestion generating in an IP router, and (b) shows the processing at the time of network congestion generating, respectively. If drawing 4 (a) is referred to, the processing at the time of congestion generating in an IP router will consist of the congestion continuation timer starting step 41, the IP packet abandonment step 42, the abandonment IP packet transmitting former notice step 43, an abandonment IP packet transfer priority upper-limit rise step 44, and an abandonment IP packet transfer priority upper-limit downward step 45. When drawing 4 (b) is referred to, the processing at the time of network congestion generating The notice step 51 of hard flow congestion, and the congestion continuation timer starting step 52, The IP packet abandonment step 53 and the abandonment IP packet transmitting former notice step 54, The transfer IP packet abandonment priority allocation step 55 and Delete Priority parameter setting step 56, Delete It consists of the Priority parameter mapping step 57, the abandonment IP packet transfer priority upper-limit rise step 58, a notice step 59 of network congestion recovery, and an abandonment IP packet transfer priority upper-limit downward step 60.
[0030] Next, actuation of the priority-control method of this example constituted in this way is explained.
[0031] When the end system 21 connected to LAN20 which is a TCP/IP network transmits data, the TCP layer of an end system 21 determines the transfer priority which corresponds out of the transfer priority of 8 level with the transfer priority decision means 1 according to the traffic property of the TCP user data 11 passed from the upper layer. That is, from a TCP port number, the classification of the TCP user data 11 is identified, and a transfer priority is determined from the correspondence table of the user-data classification (traffic property) and the transfer priority which are beforehand defined as the end system 21. The integer of 0-7 defines a transfer priority, a priority of 0 is the lowest and 7 presupposes that a priority is the highest. For example, data delivery nature like SMTP (E-mail) assigns a low priority (0-3) to the traffic seldom demanded, a higher priority (4-6) is assigned to the bulk transfer traffic as which data delivery nature like FTP (file transfer) or NFS (Network File System) is required, and 7 is

assigned to network control traffic still like SNMP (network administration) whenever [of the highest priority] (step 31). The value of the determined transfer priority is set as the Priority service parameter of IP layer. A Priority service parameter is the service interface of IP layer which this invention defined newly (step 32).
[0032] Next, IP layer of an end system 21 maps the Priority service parameter of IP layer in the Precedence parameter of the "TYPE OFSERVICE" field of IP header with IP priority parameter setting means 3. The Precedence parameter is defined from the former as a parameter which sets up the transfer priority of IP datagram, consists of triplets and can define the priority of 8 level. The value 0 of a priority is the lowest and the value 7 is prescribed that a priority is the highest (step 33). IP packet 12 is sent out to IP router 22.
[0033] IP router 22 relays IP packet 12 which received from LAN20 to IP router 22 of the destination via a network 10. When the congestion in IP router 22 is detected, by the IP packet abandonment control means 5 by the transfer priority, IP layer of IP router 22 starts a congestion continuation timer (not shown) (step 41), checks the Precedence parameter of IP packet 12, and discards IP packet 12 with a low transfer priority. For example, a Precedence parameter value discards IP packet 12 of 0-2 (step 42).
[0034] Furthermore, IP / ICMP layer of IP router 22 are Source. By the Quench packet sending-out means 6, it is Source. By transmitting towards the end system 21 of a transmitting agency with [which discarded the Quench packet 13] IP packet 12, abandonment generating of IP packet 12 by the congestion at the time of junction is notified to the end system 21 of a transmitting agency (step 43).
[0035] When a congestion continuation timer carries out a time-out, IP layer of IP router 22 discards an IP packet with a still higher transfer priority by the IP packet abandonment control means 5 by the transfer priority. Thus, whenever a congestion continuation timer carries out a time-out, the upper limit of the transfer priority of IP packet 12 to discard is raised (step 44).
[0036] On the other hand, when IP layer of IP router 22 detects the congestion recovery in IP router 22 before the congestion continuation timer carried out the time-out, IP layer of IP router 22 lowers gradually the upper limit of the transfer priority of IP packet 12 discarded according to a slow start mechanism by the IP packet abandonment control means 5 by the transfer priority (step 45).
[0037] The end system 21 of a transmitting agency is Source from IP router 22. If the Quench packet 13 is received, the IP/ICMP layer of an end system 21 will notify that abandonment of IP packet 12 occurred at the time of junction to the TCP layer of an end system 21 by the congestion in an IP router with the notice means 4 of congestion (step 34).
[0038] The TCP layer of an end system 21 controls transmission of the TCP user data 11 with a low transfer priority with the TCP user data flow control means 2 by the transfer priority. For example, a transfer priority once stops transmission of the TCP user data 11 of 0-2 (step 35). Next, the count of the notice of congestion from IP layer is measured between the measuring times T (step 36). When larger than the set point with the measurement value, a TCP layer also inhibits transmission of the TCP user data 11 with a still higher transfer priority with the TCP user data flow control means 2 by the transfer priority.
[0039] As long as the above-mentioned measurement value is larger than the above-mentioned set point, the TCP layer of an end system 21 also inhibits transmission of the TCP user data 11 with a still higher transfer priority with the TCP user data flow control means 2 by the transfer priority. Thus, the upper limit of the transfer priority of the TCP user data 11 which inhibits transmission is raised to every time amount T (step 37).
[0040] On the other hand, when the count of the notice of congestion between the measuring times T becomes below the above-mentioned set point, the TCP layer of an end system 21 lowers gradually the upper limit of the transfer priority of the TCP user data 11 which inhibits transmission to every time amount T according to the slow start mechanism with the TCP user data flow control means 2 by the transfer priority (step 38).
[0041] If congestion occurs with a network 10 when IP router 22 is connected to the network 10 which has a notice function of congestion, DL core layer (when a network 10 is a Frame Relay network) of IP router 22 of **** or an ATM layer will notify network congestion generating to a

network 10 with network congestion and the notice means 8 of recovery at IP / ICMP layer based on the notice detection of hard flow congestion from a network 10 (step 51). (when a network 10 is an ATM network)
[0042] By the IP packet abandonment control means 5 by the transfer priority, the IP/ICMP layer of IP router 22 starts a congestion continuation timer (step 52), checks the Precedence parameter of IP packet 12 under junction processing, and discards IP packet 12 with a low transfer priority. For example, a Precedence parameter value discards IP packet 12 of 0-2 (step 53). Furthermore, an IP/ICMP layer is Source. By the Quench packet sending-out means 6, it is Source. It transmits towards the end system 21 of a transmitting agency with [which discarded the Quench packet 13] IP packet 12 (step 54).
[0043] On the other hand, it is Source. After transmitting to the end system 21 of the transmitting origin of the Quench packet 13, the IP/ICMP layer of IP router 22 assigns the abandonment priority of 2 level according to a transfer priority further to IP packet 12 to relay with the abandonment priority allocation means 7. For example, a Precedence parameter value assigns the abandonment priority 1 to IP packet 12 of 3-5, and a Precedence parameter value assigns the abandonment priority 0 to IP packet 12 of 6 and 7 (step 55).
[0044] The IP/ICMP layer of IP router 22 is Delete of a data link layer about the above-mentioned abandonment priority. It is set as a Priority service parameter. Delete A Priority service parameter is the service interface of the data link layer which this invention defined newly (step 56).
[0045] Next, IP router 22 maps the assigned abandonment priority in the abandonment priority parameter of the protocol header below a data link layer. When a network 10 is a Frame Relay network, DL core layer of IP router 22 is Delete by the lower layer abandonment priority parameter setting means 9. A Priority service parameter is mapped in DE (abandonment is possible) bit of DL core header. Namely, Delete Priority service parameter = in the case of 1, it is referred to as DE bit =ON, and is Delete. Priority service parameter = in the case of 0, it is referred to as DE bit =OFF. DE bit = the frame of ON is preferentially discarded with a network 10 at the time of congestion generating in a network 10 (step 57).
[0046] Moreover, when a network 10 is an ATM network, the ATM layer of IP router 22 is Delete by the lower layer abandonment priority parameter setting means 9. A Priority service parameter is mapped in the CLP (cel abandonment priority) bit of an ATM cel header. Namely, Delete Priority service parameter = in the case of 1, it is referred to as CLP bit =ON, and is Delete. Priority service parameter = in the case of 0, it is referred to as CLP bit =OFF. CLP bit = the frame of ON is preferentially discarded with a network 10 at the time of congestion generating in a network 10 (step 57).
[0047] When a congestion continuation timer carries out a time-out, the IP/ICMP layer of IP router 22 discards IP packet 12 with a still higher transfer priority by the IP packet abandonment control means 5 by the transfer priority. Thus, whenever a congestion continuation timer carries out a time-out, the transfer priority of an abandonment upper limit is raised (step 58).
[0048] On the other hand, when IP / ICMP layer receives the notice of network congestion recovery from DL core layer or an ATM layer before the congestion continuation timer carried out the time-out (step 59), IP / ICMP layer of IP router 22 lower gradually the upper limit of the transfer priority of IP packet 12 discarded according to a slow start mechanism by the IP packet abandonment control means 5 by the transfer priority (step 60).
[0049] Thus, in the above-mentioned example, in an end system 21, a TCP layer determines a transfer priority with the traffic property of the data from the upper layer, and maps the determined transfer priority in the transfer priority parameter of IP layer. For this reason, in a TCP/IP network, an end system 21 becomes possible [setting the transfer priority according to a traffic property as each IP packet 12 to send out].
[0050] Moreover, IP router 22 checks the transfer priority parameter of IP packet 12 which receives congestion generating in an IP router and recovery, or the notice of network congestion at the time of detection, and controls abandonment of IP packet 12 with a low transfer priority. Moreover, the transfer priority of IP packet 12 is mapped in the abandonment priority parameter of the protocol header below a data link layer. For this reason, IP router 22 becomes possible

[performing the priority control of data transfer according to the traffic property of high order application] to the congestion in an IP router, or the notice of network congestion.
[0051] Furthermore, IP router 22 is Source about abandonment generating of IP packet 12 by congestion. The Quench packet 13 notifies to the end system 21 of a transmitting agency, and an end system 21 controls transmitting suppression of the TCP user data 11 with a low transfer priority based on the measurement value of the count of the notice of congestion. This becomes possible also in an end system 21 to perform a transmission control based on the data transfer priority according to a traffic property to congestion.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the configuration of the priority-control method concerning one example of this invention.
[Drawing 2] It is the conceptual diagram of the network where the priority-control method of this example is contained.
[Drawing 3] It is a control flow chart in the end system in drawing 1 , and for (a), it is processing at the time of data transmission, and (b) is Source. The processing at the time of Quench packet reception is shown, respectively.
[Drawing 4] It is a control flow chart in the IP router in drawing 1 , and (a) shows the processing at the time of congestion generating in an IP router, and (b) shows the processing at the time of network congestion generating, respectively.
[Description of Notations]
1 Transfer Priority Decision Means
2 TCP User Data Flow Control Means by Transfer Priority
3 IP Priority Parameter Setting Means
4 Notice Means of Congestion
5 IP Packet Abandonment Control Means by Transfer Priority
6 Source Quench Packet Sending-Out Means
7 Abandonment Priority Allocation Means
8 Network Congestion and Notice Means of Recovery
9 Lower Layer Abandonment Priority Parameter Setting Means
10 Network (Frame Relay Network / ATM Network)
11 TCP User Data
12 IP Packet
13 Source Quench Packet
14 Precedence Parameter
20 LAN (TCP/IP Network)
21 End System
22 IP Router

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平9－205461

(43)公開日　平成９年(1997)８月５日

(51)Int.Cl.*		識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｈ０４Ｌ	12/56		9466－5K	Ｈ０４Ｌ	11/20	１０２Ａ
	12/46			Ｈ０４Ｑ	3/00	
	12/28			Ｈ０４Ｌ	11/00	３１０Ｃ
	29/06				13/00	３０５Ｄ
Ｈ０４Ｑ	3/00					

審査請求　有　　請求項の数４　ＦＤ　（全 10 頁）

(21)出願番号　特願平8－34300

(22)出願日　平成８年(1996)１月29日

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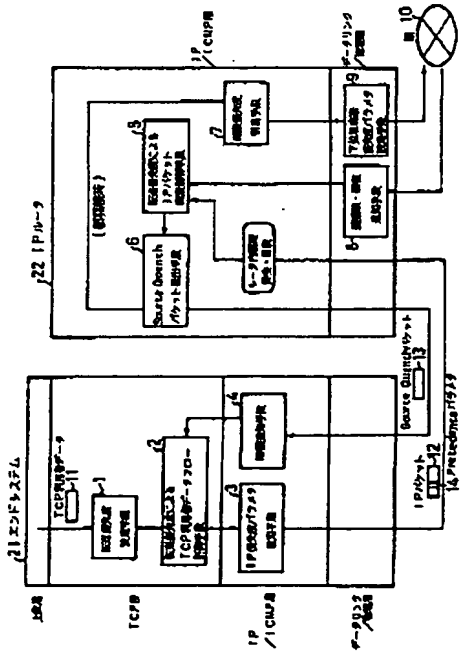
(54)【発明の名称】　優先制御方式

(57)【要約】

【課題】　ＩＰルータ内輻輳あるいは網輻輳に対して、上位アプリケーション種別によるトラヒック特性に応じたデータ転送の優先制御を可能とする。

【解決手段】　転送優先度決定手段１は上位層からのデータのトラヒック特性に応じて転送優先度を決定し、ＩＰ優先度パラメタ設定手段３は転送優先度をＰｒｅｃｅｄｅｎｃｅパラメタ１４にマッピングしてＩＰパケット１２をＩＰルータ２２に送出する。転送優先度によるＩＰパケット廃棄制御手段５はＰｒｅｃｅｄｅｎｃｅパラメタ１４をチェックして転送優先度の低いＩＰパケット１２の廃棄を制御し、Ｓｏｕｒｃｅ　Ｑｕｅｎｃｈパケット送出手段６はＩＰパケット１２の廃棄発生をＳｏｕｒｃｅ　Ｑｕｅｎｃｈパケット１３により送信元のエンドシステム２１に通知する。転送優先度によるＴＣＰ利用者データフロー制御手段２は転送優先度の低いＴＣＰ利用者データ１１の送信抑止を制御する。



【特許請求の範囲】

【請求項１】 ＴＣＰ／ＩＰネットワークのＬＡＮに接続されたエンドシステムにおいて、

ＴＣＰ層で上位層からのデータのトラヒック特性に応じて転送優先度を決定する転送優先度決定手段と、

この転送優先度決定手段により決定された転送優先度をＩＰ層の「ＴＹＰＥＯＦ ＳＥＲＶＩＣＥ」フィールドのＰｒｅｃｅｄｅｎｃｅパラメタにマッピングしてＩＰパケットをＩＰルータに送出するＩＰ優先度パラメタ設定手段と、

前記ＩＰルータからのＳｏｕｒｃｅ Ｑｕｅｎｃｈパケットの受信時に中継時の輻輳によるＩＰパケットの廃棄発生をＩＰ／ＩＣＭＰ層からＴＣＰ層に通知する輻輳通知手段と、

ＩＰ／ＩＣＭＰ層からの輻輳通知回数の計測値に基づきＴＣＰ層で転送優先度の低いＴＣＰ利用者データの送信抑止を制御する転送優先度によるＴＣＰ利用者データフロー制御手段とを有し、

ＴＣＰ／ＩＰネットワークのＩＰルータにおいて、

ＩＰルータ内輻輳発生あるいは回復検出時にＩＰ／ＩＣＭＰ層で受信したＩＰパケットのＰｒｅｃｅｄｅｎｃｅパラメタをチェックして転送優先度の低いＩＰパケットの廃棄を制御する転送優先度によるＩＰパケット廃棄制御手段と、

この転送優先度によるＩＰパケット廃棄制御手段による中継時の輻輳によるＩＰパケットの廃棄発生をＳｏｕｒｃｅ Ｑｕｅｎｃｈパケットにより送信元のエンドシステムに通知するＳｏｕｒｃｅ Ｑｕｅｎｃｈパケット送出手段とを有することを特徴とする優先制御方式。

【請求項２】 前記ＩＰルータが輻輳通知機能を有する網に接続されている場合に、前記ＩＰルータのデータリンク層以下で前記網からの逆方向輻輳通知検出に基づき網輻輳発生あるいは回復をＩＰ／ＩＣＭＰ層に通知する網輻輳・回復通知手段と、前記転送優先度によるＩＰパケット廃棄制御手段により廃棄されたＩＰパケットを前記Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット送出手段によりＳｏｕｒｃｅ Ｑｕｅｎｃｈパケットに付加して送信元のエンドシステムに通知した後に中継するＩＰパケットに転送優先度に応じた廃棄優先度を割り当てる廃棄優先度割当手段と、この廃棄優先度割当手段により割り当てられた廃棄優先度をデータリンク層以下のプロトコルヘッダの廃棄優先度パラメタにマッピングする下位層廃棄優先度パラメタ設定手段とを含む請求項１記載の優先制御方式。

【請求項３】 前記網がフレームリレー網である場合に、前記廃棄優先度割当手段が廃棄優先度をデータリンク層のＤｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタに設定し、前記下位層廃棄優先度パラメタ設定手段が前記データリンク層のＤｅｌｅｔｅ ＰｒｉｏｒｉｔｙサービスパラメタをＤＬコアヘッダのＤＥビットにマッピングする請求項２記載の優先制御方式。

【請求項４】 前記網がＡＴＭ網である場合に、前記廃棄優先度割当手段が廃棄優先度をデータリンク層のＤｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタに設定し、前記下位層廃棄優先度パラメタ設定手段が前記データリンク層のＤｅｌｅｔｅ ＰｒｉｏｒｉｔｙサービスパラメタをＡＴＭセルヘッダのＣＬＰビットにマッピングする請求項２記載の優先制御方式。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は優先制御方式に関し、特にＴＣＰ（Ｔｒａｎｓｍｉｓｓｉｏｎ Ｃｏｎｔｒｏｌ Ｐｒｏｔｏｃｏｌ）／ＩＰ（Ｉｎｔｅｒｎｅｔ Ｐｒｏｔｏｃｏｌ）ネットワークにおける優先制御方式に関する。

【０００２】

【従来の技術】従来、ＴＣＰ／ＩＰネットワークにおいて、ＴＣＰ層では、ＴＣＰ利用者データの種別（トラヒック特性）により転送優先度を決定することは行われていない。一方、ＩＰ層には、ＩＰデータグラムの転送優先度を設定するパラメタとして、「ＴＹＰＥ ＯＦ ＳＥＲＶＩＣＥ」フィールドのＰｒｅｃｅｄｅｎｃｅパラメタが規定されているが（例えば、Ｄｏｕｇｌａｓ Ｃｏｍｅｒ著／村井純・楠本博之訳「ＴＣＰ／ＩＰによるネットワーク構築－原理・プロトコル・アーキテクチャー」，第５６頁，共立出版株式会社，１９９０年７月発行，参照）、Ｐｒｅｃｅｄｅｎｃｅパラメタとと ＩＰ層のサービスパラメタとのマッピングが規定されていないため、従来のエンドシステムおよびＩＰルータでは使用されていなかった。

【０００３】また、フレームリレーＤＬ（Ｄａｔａ Ｌｉｎｋ）コア層や、ＡＴＭ（Ａｓｙｎｃｈｒｏｎｏｕｓ Ｔｒａｎｓｆｅｒ Ｍｏｄｅ）層に定義されている、フレームあるいはセルの廃棄優先度パラメタと、Ｐｒｅｃｅｄｅｎｃｅパラメタとのマッピングについても規定されていないため、従来のエンドシステムおよびＩＰルータでは使用されていなかった。

【０００４】

【発明が解決しようとする課題】上述した従来の技術では、Ｐｒｅｃｅｄｅｎｃｅパラメタおよび廃棄優先度パラメタが使用されていなかったので、ＩＰルータ内輻輳あるいは網輻輳発生時に、ＩＰルータは、上位アプリケーション種別によるトラヒック特性に応じたデータ転送の優先制御は行えず、トラヒック特性とは無関係にＩＰデータグラムを廃棄してしまうという問題点が発生していた。

【０００５】また、エンドシステムにおいても、上記輻輳発生時に、トラヒック特性に応じたデータの転送優先度に基づいて送信制御を行うことができないという問題点があった。

【０００６】上記問題点のために、ＩＰルータあるいは網での輻輳による上位アプリケーションへの影響、特に、複数のトラヒック特性が混在しているマルチメディア情報の円滑な通信が実現できないという事態が発生していた。

【０００７】本発明の目的は、ＴＣＰ／ＩＰネットワークにおいて、ＩＰルータ内輻輳あるいは網輻輳、特にフレームリレー網やＡＴＭ網の輻輳に対して、上位アプリケーション種別によるトラヒック特性に応じたデータ転送の優先制御を可能とする優先制御方式を提供することにある。

【０００８】

【課題を解決するための手段】本発明の優先制御方式は、ＴＣＰ／ＩＰネットワークのＬＡＮに接続されたエンドシステムにおいて、ＴＣＰ層で上位層からのデータのトラヒック特性に応じて転送優先度を決定する転送優先度決定手段と、この転送優先度決定手段により決定された転送優先度をＩＰ層の「ＴＹＰＥ　ＯＦ　ＳＥＲＶＩＣＥ」フィールドのＰｒｅｃｅｄｅｎｃｅパラメタにマッピングしてＩＰパケットをＩＰルータに送出するＩＰ優先度パラメタ設定手段と、前記ＩＰルータからのＳｏｕｒｃｅＱｕｅｎｃｈパケットの受信時に中継時の輻輳によるＩＰパケットの廃棄発生をＩＰ／ＩＣＭＰ層からＴＣＰ層に通知する輻輳通知手段と、ＩＰ／ＩＣＭＰ層からの輻輳通知回数の計測値に基づきＴＣＰ層で転送優先度の低いＴＣＰ利用者データの送信抑止を制御する転送優先度によるＴＣＰ利用者データフロー制御手段とを有し、ＴＣＰ／ＩＰネットワークのＩＰルータにおいて、ＩＰルータ内輻輳発生あるいは回復検出時にＩＰ／ＩＣＭＰ層で受信したＩＰパケットのＰｒｅｃｅｄｅｎｃｅパラメタをチェックして転送優先度の低いＩＰパケットの廃棄を制御する転送優先度によるＩＰパケット廃棄制御手段と、この転送優先度によるＩＰパケット廃棄制御手段による中継時の輻輳によるＩＰパケットの廃棄発生をＳｏｕｒｃｅ　Ｑｕｅｎｃｈパケットにより送信元のエンドシステムに通知するＳｏｕｒｃｅ　Ｑｕｅｎｃｈパケット送出手段とを有することを特徴とする。

【０００９】さらに、本発明の優先制御方式は、前記ＩＰルータが輻輳通知機能を有する網に接続されている場合に、前記ＩＰルータのデータリンク層以下で前記網からの逆方向輻輳通知検出に基づき網輻輳発生あるいは回復をＩＰ／ＩＣＭＰ層に通知する網輻輳・回復通知手段と、前記転送優先度によるＩＰパケット廃棄制御手段により廃棄されたＩＰパケットを前記Ｓｏｕｒｃｅ　Ｑｕｅｎｃｈパケット送出手段によりＳｏｕｒｃｅ　Ｑｕｅｎｃｈパケットに付加して送信元のエンドシステムに通知した後に中継するＩＰパケットに転送優先度に応じた廃棄優先度を割り当てる廃棄優先度割当手段と、この廃棄優先度割当手段により割り当てられた廃棄優先度をデータリンク層以下のプロトコルヘッダの廃棄優先度パラメタにマッピングする下位層廃棄優先度パラメタ設定手段とを含む。

【００１０】

【発明の実施の形態】次に、本発明について図面を参照しながら詳細に説明する。

【００１１】

【実施例】図２は、本発明の一実施例に係る優先制御方式が含まれるネットワークの概念図である。図２において、エンドシステム２１は、ＴＣＰ／ＩＰネットワークであるＬＡＮ（Ｌｏｃａｌ　Ａｒｅａ　Ｎｅｔｗｏｒｋ）２０に収容されており、ＩＰルータ２２および網１０を経由して、リモートのＴＣＰ／ＩＰネットワークであるＬＡＮ２０に収容されているエンドシステム２１と通信を行う。

【００１２】エンドシステム２１の物理層からデータリンク層にはＬＡＮ２０に依存するプロトコルが搭載され、さらにその上位層にＴＣＰ／ＩＰプロトコルが搭載されている。

【００１３】ＩＰルータ２２は、ＬＡＮ２０を収容し、網１０に直収されている。ＩＰルータ２２は、ＩＰパケットをそのＩＰアドレスにより中継する機能（ＩＰルーティング機能）を有しており、物理層からデータリンク層は、網１０とのＵＮＩ（ユーザ・網インタフェース）に応じたプロトコルを搭載している。図２では、網１０は、フレームリレー網あるいはＡＴＭ網であるため、ＩＰルータ２２は、ＤＬコア層（網１０がフレームリレー網の場合）またはＡＴＭ層（網１０がＡＴＭ網の場合）を有する。

【００１４】図１は、本発明の一実施例に係る優先制御方式の構成を示すブロック図である。本実施例の優先制御方式は、網１０と、エンドシステム２１と、ＩＰルータ２２とから、その主要部が構成されている。

【００１５】エンドシステム２１のＴＣＰ層には、転送優先度決定手段１と、転送優先度によるＴＣＰ利用者データフロー制御手段２とが含まれる。

【００１６】転送優先度決定手段１は、上位層からのＴＣＰ利用者データ１１のトラヒック特性により転送優先度を決定する。

【００１７】転送優先度によるＴＣＰ利用者データフロー制御手段２は、ＩＰ／ＩＣＭＰ（Ｉｎｔｅｒｎｅｔ　Ｃｏｎｔｒｏｌ　Ｍｅｓｓａｇｅ　Ｐｒｏｔｏｃｏｌ）層からの輻輳通知回数の計測値に基づき、転送優先度の低いＴＣＰ利用者データ１１の送信抑止を制御する。

【００１８】エンドシステム２１のＩＰ／ＩＣＭＰ層には、ＩＰ優先度パラメタ設定手段３と、輻輳通知手段４とが含まれる。

【００１９】ＩＰ優先度パラメタ設定手段３は、ＴＣＰ層で決定した転送優先度をＩＰ層の「ＴＹＰＥ　ＯＦ　ＳＥＲＶＩＣＥ」フィールドのＰｒｅｃｅｄｅｎｃｅパラメタ１４にマッピングし、ＩＰパケット１２をＩＰル

ータ２２に送出する。

【００２０】輻輳通知手段４は、ＩＰルータ２２からのＳｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３の受信時に、中継時の輻輳によるＩＰパケット１２の廃棄発生をエンドシステム２１のＩＰ／ＩＣＭＰ層からＴＣＰ層に通知する。

【００２１】ＩＰルータ２２のＩＰ／ＩＣＭＰ層には、転送優先度によるＩＰパケット廃棄制御手段５と、Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット送出手段６と、廃棄優先度割当手段７とが含まれる。

【００２２】転送優先度によるＩＰパケット廃棄制御手段５は、ＩＰルータ内輻輳発生・回復検出時に、あるいはデータリンク／物理層に含まれる網輻輳・回復通知手段８からの通知を受けたときに、受信したＩＰパケット１２のＰｒｅｃｅｄｅｎｃｅパラメタ１４をチェックし、優先度の低いＩＰパケット１２の廃棄を制御する。

【００２３】Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット送出手段６は、転送優先度によるＩＰパケット廃棄制御手段５において廃棄されたＩＰパケット１２をＳｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３に載せて送信元のエンドシステム２１に輻輳発生を通知する。

【００２４】廃棄優先度割当手段７は、網輻輳時のＳｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３を送出後、中継するＩＰパケット１２に転送優先度に応じて廃棄優先度を割り当てる。

【００２５】ＩＰルータ２２のデータリンク／物理層には、網輻輳・回復通知手段８と、下位層廃棄優先度パラメタ設定手段９とが含まれる。例えば、ＩＰルータ２２が接続される網１０がフレームリレー網の場合、上記各手段はＤＬコア層に含まれ、またＩＰルータ２２がＡＴＭ網に接続されている場合は、上記各手段はＡＴＭ層に含まれる。

【００２６】網輻輳・回復通知手段８は、網１０からの逆方向輻輳通知検出に基づき、網輻輳発生あるいは回復をＩＰ層に通知する。

【００２７】下位層廃棄優先度パラメタ設定手段９は、ＩＰ／ＩＣＭＰ層の廃棄優先度割当手段７によって割り当てられた廃棄優先度を、データリンク層以下のプロトコルヘッダの廃棄優先度パラメタにマッピングする。廃棄優先度パラメタは、具体的には、フレームリレーのＤＬコアヘッダのＤＥ（廃棄可能）ビット、あるいはＡＴＭセルヘッダのＣＬＰ（セル廃棄優先度）ビットに相当する。

【００２８】図３は、エンドシステム２１における制御フローチャートであり、（ａ）はデータ送信時の処理を、（ｂ）はＳｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３の受信時の処理をそれぞれ示す。図３（ａ）を参照すると、データ送信時の処理は、転送優先度決定ステップ３１と、Ｐｒｉｏｌｔｙサービスパラメタ設定ステップ３２と、Ｐｒｅｃｅｎｄｅｎｃｅパラメタマッピングステップ３３とからなる。図３（ｂ）を参照すると、Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３の受信時の処理は、ＩＰパケット廃棄通知ステップ３４と、ＴＣＰ利用者データ送信抑止ステップ３５と、輻輳通知回数計測ステップ３６と、転送優先度上限値上昇ステップ３７と、転送優先度上限値下降ステップ３８とからなる。

【００２９】図４は、ＩＰルータ２２における制御フローチャートであり、（ａ）はＩＰルータ内輻輳発生時の処理を、（ｂ）は網輻輳発生時の処理をそれぞれ示す。図４（ａ）を参照すると、ＩＰルータ内輻輳発生時の処理は、輻輳継続タイマ起動ステップ４１と、ＩＰパケット廃棄ステップ４２と、廃棄ＩＰパケット送信元通知ステップ４３と、廃棄ＩＰパケット転送優先度上限値上昇ステップ４４と、廃棄ＩＰパケット転送優先度上限値下降ステップ４５とからなる。図４（ｂ）を参照すると、網輻輳発生時の処理は、逆方向輻輳通知ステップ５１と、輻輳継続タイマ起動ステップ５２と、ＩＰパケット廃棄ステップ５３と、廃棄ＩＰパケット送信元通知ステップ５４と、転送ＩＰパケット廃棄優先度割当ステップ５５と、Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙパラメタ設定ステップ５６と、Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙパラメタマッピングステップ５７と、廃棄ＩＰパケット転送優先度上限値上昇ステップ５８と、網輻輳回復通知ステップ５９と、廃棄ＩＰパケット転送優先度上限値下降ステップ６０とからなる。

【００３０】次に、このように構成された本実施例の優先制御方式の動作について説明する。

【００３１】ＴＣＰ／ＩＰネットワークであるＬＡＮ２０に接続されたエンドシステム２１がデータを送信するときに、エンドシステム２１のＴＣＰ層は、転送優先度決定手段１により、上位層から渡されたＴＣＰ利用者データ１１のトラヒック特性に応じて８レベルの転送優先度の中から相当する転送優先度を決定する。すなわち、ＴＣＰポート番号より、そのＴＣＰ利用者データ１１の種別を識別し、あらかじめエンドシステム２１に定義しておく利用者データ種別（トラヒック特性）と転送優先度との対応テーブルから転送優先度を決定する。転送優先度は、０～７の整数で定義し、０が最も優先度が低く、７が最も優先度が高いとする。例えば、ＳＭＴＰ（Ｅ－ｍａｉｌ）のようなデータ送達性があまり要求されないトラヒックには低い優先度（０～３）を割り当て、ＦＴＰ（ファイル転送）やＮＦＳ（ネットワークファイルシステム）のようなデータ送達性が要求されるバルク転送トラヒックには高めの優先度（４～６）を割り当て、さらに、ＳＮＭＰ（ネットワーク管理）のようなネットワーク制御トラヒックには最優先度７を割り当てる（ステップ３１）。決定した転送優先度の値をＩＰ層のＰｒｉｏｒｉｔｙサービスパラメタに設定する。Ｐｒｉｏｒｉｔｙサービスパラメタは、本発明で新規に定義したＩＰ層のサービスインタフェースである（ステップ

３２）。

【００３２】次に、エンドシステム２１のＩＰ層は、ＩＰ優先度パラメタ設定手段３により、ＩＰ層のＰｒｉｏｒｉｔｙサービスパラメタをＩＰヘッダの「ＴＹＰＥ ＯＦＳＥＲＶＩＣＥ」フィールドのＰｒｅｃｅｄｅｎｃｅパラメタにマッピングする。Ｐｒｅｃｅｄｅｎｃｅパラメタは、ＩＰデータグラムの転送優先度を設定するパラメタとして従来から定義されており、３ビットから構成され、８レベルの優先度を定義することができる。値０が最も優先度が低く、値７が最も優先度が高いと規定されている（ステップ３３）。ＩＰパケット１２をＩＰルータ２２に送出する。

【００３３】ＩＰルータ２２は、ＬＡＮ２０から受信したＩＰパケット１２を網１０を経由して転送先のＩＰルータ２２に中継する。ＩＰルータ２２のＩＰ層は、ＩＰルータ２２内の輻輳を検出した場合、転送優先度によるＩＰパケット廃棄制御手段５により、輻輳継続タイマ（図示せず）を起動し（ステップ４１）、ＩＰパケット１２のＰｒｅｃｅｄｅｎｃｅパラメタをチェックし、転送優先度の低いＩＰパケット１２を廃棄する。例えば、Ｐｒｅｃｅｄｅｎｃｅパラメタ値が０～２のＩＰパケット１２を廃棄する（ステップ４２）。

【００３４】さらに、ＩＰルータ２２のＩＰ／ＩＣＭＰ層は、Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット送出手段６により、Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３を廃棄したＩＰパケット１２付きで送信元のエンドシステム２１に向けて送信することにより、中継時の輻輳によるＩＰパケット1.2の廃棄発生を送信元のエンドシステム２１に通知する（ステップ４３）。

【００３５】輻輳継続タイマがタイムアウトした場合、ＩＰルータ２２のＩＰ層は、転送優先度によるＩＰパケット廃棄制御手段５により、さらに転送優先度の高いＩＰパケットを廃棄する。このようにして、輻輳継続タイマがタイムアウトする毎に、廃棄するＩＰパケット１２の転送優先度の上限値を上げていく（ステップ４４）。

【００３６】一方、輻輳継続タイマがタイムアウトする前に、ＩＰルータ２２のＩＰ層がＩＰルータ２２内の輻輳回復を検出した場合、ＩＰルータ２２のＩＰ層は、転送優先度によるＩＰパケット廃棄制御手段５により、スロースタートメカニズムによって廃棄するＩＰパケット１２の転送優先度の上限値を徐々に下げていく（ステップ４５）。

【００３７】送信元のエンドシステム２１がＩＰルータ２２からＳｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３を受信すると、エンドシステム２１のＩＰ／ＩＣＭＰ層は、輻輳通知手段４により、ＩＰルータ内輻輳によってＩＰパケット１２の廃棄が中継時に発生したことをエンドシステム２１のＴＣＰ層に通知する（ステップ３４）。

【００３８】エンドシステム２１のＴＣＰ層は、転送優先度によるＴＣＰ利用者データフロー制御手段２により、転送優先度の低いＴＣＰ利用者データ１１の送信を抑制する。例えば、転送優先度が０～２のＴＣＰ利用者データ１１の送信を一旦中止する（ステップ３５）。次に、測定時間Ｔの間にＩＰ層からの輻輳通知回数を計測する（ステップ３６）。その計測値がある設定値よりも大きい場合、ＴＣＰ層は、転送優先度によるＴＣＰ利用者データフロー制御手段２により、さらに転送優先度の高いＴＣＰ利用者データ１１の送信も抑止する。

【００３９】上記計測値が上記設定値よりも大きい限り、エンドシステム２１のＴＣＰ層は、転送優先度によるＴＣＰ利用者データフロー制御手段２により、さらに転送優先度の高いＴＣＰ利用者データ１１の送信も抑止する。このようにして、時間Ｔ毎に送信を抑止するＴＣＰ利用者データ１１の転送優先度の上限値を上げていく（ステップ３７）。

【００４０】一方、測定時間Ｔの間の輻輳通知回数が上記設定値以下になった場合、エンドシステム２１のＴＣＰ層は、転送優先度によるＴＣＰ利用者データフロー制御手段２により、スロースタートメカニズムによって時間Ｔ毎に送信を抑止するＴＣＰ利用者データ１１の転送優先度の上限値を徐々に下げていく（ステップ３８）。

【００４１】もし、ＩＰルータ２２が輻輳通知機能を有する網１０に接続されている場合、網１０で輻輳が発生すると、網１０に直収のＩＰルータ２２のＤＬコア層（網１０がフレームリレー網の場合）またはＡＴＭ層（網１０がＡＴＭ網の場合）は、網１０からの逆方向輻輳通知検出に基づき、網輻輳・回復通知手段８により、網輻輳発生をＩＰ／ＩＣＭＰ層に通知する（ステップ５１）。

【００４２】ＩＰルータ２２のＩＰ／ＩＣＭＰ層は、転送優先度によるＩＰパケット廃棄制御手段５により、輻輳継続タイマを起動し（ステップ５２）、中継処理中のＩＰパケット１２のＰｒｅｃｅｄｅｎｃｅパラメタをチェックし、転送優先度の低いＩＰパケット１２を廃棄する。例えば、Ｐｒｅｃｅｄｅｎｃｅパラメタ値が０～２のＩＰパケット１２を廃棄する（ステップ５３）。さらに、ＩＰ／ＩＣＭＰ層は、Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット送出手段６により、Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３を廃棄したＩＰパケット１２付きで送信元のエンドシステム２１に向けて送信する（ステップ５４）。

【００４３】一方、Ｓｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３の送信元のエンドシステム２１への送信後、ＩＰルータ２２のＩＰ／ＩＣＭＰ層は、廃棄優先度割当手段７により、中継するＩＰパケット１２にさらに転送優先度に応じた２レベルの廃棄優先度を割り当てる。例えば、Ｐｒｅｃｅｄｅｎｃｅパラメタ値が３～５のＩＰパケット１２に廃棄優先度１を割り当て、Ｐｒｅｃｅｄｅｎｃｅパラメタ値が６，７のＩＰパケット１２に廃棄優先度０を割り当てる（ステップ５５）。

【００４４】ＩＰルータ２２のＩＰ／ＩＣＭＰ層は、上記廃棄優先度をデータリンク層のＤｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタに設定する。Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタは、本発明で新規に定義したデータリンク層のサービスインタフェースである（ステップ５６）。

【００４５】次に、ＩＰルータ２２は、割り当てた廃棄優先度を、データリンク層以下のプロトコルヘッダの廃棄優先度パラメタにマッピングする。網１０がフレームリレー網の場合、ＩＰルータ２２のＤＬコア層は、下位層廃棄優先度パラメタ設定手段９により、Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタを、ＤＬコアヘッダのＤＥ（廃棄可能）ビットにマッピングする。すなわち、Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタ＝１の場合、ＤＥビット＝ＯＮとし、Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタ＝０の場合、ＤＥビット＝ＯＦＦとする。ＤＥビット＝ＯＮのフレームは、網１０における輻輳発生時に、網１０により優先的に廃棄される（ステップ５７）。

【００４６】また、網１０がＡＴＭ網の場合、ＩＰルータ２２のＡＴＭ層は、下位層廃棄優先度パラメタ設定手段９により、Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタを、ＡＴＭセルヘッダのＣＬＰ（セル廃棄優先度）ビットにマッピングする。すなわち、Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタ＝１の場合、ＣＬＰビット＝ＯＮとし、Ｄｅｌｅｔｅ Ｐｒｉｏｒｉｔｙサービスパラメタ＝０の場合、ＣＬＰビット＝ＯＦＦとする。ＣＬＰビット＝ＯＮのフレームは、網１０における輻輳発生時に、網１０により優先的に廃棄される（ステップ５７）。

【００４７】輻輳継続タイマがタイムアウトした場合、ＩＰルータ２２のＩＰ／ＩＣＭＰ層は、転送優先度によるＩＰパケット廃棄制御手段５により、さらに転送優先度の高いＩＰパケット１２を廃棄する。このようにして、輻輳継続タイマがタイムアウトする毎に、廃棄上限の転送優先度を上げていく（ステップ５８）。

【００４８】一方、輻輳継続タイマがタイムアウトする前に、ＩＰ／ＩＣＭＰ層がＤＬコア層またはＡＴＭ層から網輻輳回復通知を受けた場合（ステップ５９）、ＩＰルータ２２のＩＰ／ＩＣＭＰ層は、転送優先度によるＩＰパケット廃棄制御手段５により、スロースタートメカニズムによって廃棄するＩＰパケット１２の転送優先度の上限値を徐々に下げていく（ステップ６０）。

【００４９】このように、上記実施例では、エンドシステム２１において、ＴＣＰ層が上位層からのデータのトラヒック特性により転送優先度を決定し、決定した転送優先度をＩＰ層の転送優先度パラメタにマッピングしている。このため、ＴＣＰ／ＩＰネットワークにおいて、エンドシステム２１は、送出する各ＩＰパケット１２にトラヒック特性に応じた転送優先度を設定することが可能となる。

【００５０】また、ＩＰルータ２２は、ＩＰルータ内輻輳発生・回復あるいは網輻輳通知を検出時、受信するＩＰパケット１２の転送優先度パラメタをチェックし、転送優先度の低いＩＰパケット１２の廃棄を制御する。また、ＩＰパケット１２の転送優先度を、データリンク層以下のプロトコルヘッダの廃棄優先度パラメタにマッピングする。このため、ＩＰルータ２２は、ＩＰルータ内輻輳あるいは網輻輳通知に対して、上位アプリケーションのトラヒック特性に応じたデータ転送の優先制御を行うことが可能となる。

【００５１】さらに、ＩＰルータ２２は、輻輳によるＩＰパケット１２の廃棄発生をＳｏｕｒｃｅ Ｑｕｅｎｃｈパケット１３により送信元のエンドシステム２１に通知し、エンドシステム２１は、輻輳通知回数の計測値に基づき、転送優先度の低いＴＣＰ利用者データ１１の送信抑止を制御する。これにより、エンドシステム２１においても、輻輳に対して、トラヒック特性に応じたデータの転送優先度に基づき送信制御を行うことが可能となる。

【００５２】

【発明の効果】以上説明したように、本発明によれば、ＴＣＰ／ＩＰネットワークにおいて、エンドシステムに転送優先度決定手段およびＩＰ優先度パラメタ設定手段を設け、ＴＣＰ層で上位層からのデータのトラヒック特性に応じて転送優先度を決定し、決定された転送優先度をＩＰ層の「ＴＹＰＥ ＯＦ ＳＥＲＶＩＣＥ」フィールドのＰｒｅｃｅｄｅｎｃｅパラメタにマッピングしてＩＰパケットをＩＰルータに送出するようにしたことにより、送出する各ＩＰパケットにトラヒック特性に応じた転送優先度を設定することが可能になるという効果がある。

【００５３】また、ＩＰルータに転送優先度によるＩＰパケット廃棄制御手段およびＳｏｕｒｃｅ Ｑｕｅｎｃｈパケット送出手段を、エンドシステムに輻輳通知手段および転送優先度によるＴＣＰ利用者データフロー制御手段を設け、ＩＰルータ内輻輳発生あるいは回復検出時に受信したＩＰパケットのＰｒｅｃｅｄｅｎｃｅパラメタをチェックして転送優先度の低いＩＰパケットの廃棄を制御し、中継時の輻輳によるＩＰパケットの廃棄発生をＳｏｕｒｃｅ Ｑｕｅｎｃｈパケットにより送信元のエンドシステムに通知し、ＩＰルータからのＳｏｕｒｃｅ Ｑｕｅｎｃｈパケットの受信時に中継時の輻輳によるＩＰパケットの廃棄発生をＩＰ／ＩＣＭＰ層からＴＣＰ層に通知し、ＩＰ／ＩＣＭＰ層からの輻輳通知回数の計測値に基づきＴＣＰ層で転送優先度の低いＴＣＰ利用者データの送信抑止を制御するようにしたことにより、ＩＰルータ内輻輳に対して上位アプリケーションのトラヒック特性に応じたデータ転送の優先制御を行うことが可能となるという効果がある。

【００５４】さらに、ＩＰルータが輻輳通知機能を有する網に接続されている場合に、ＩＰルータに網輻輳・回復通知手段，廃棄優先度割当手段および下位層廃棄優先度パラメタ設定手段を設け、データリンク層以下で網からの逆方向輻輳通知検出に基づき網輻輳発生あるいは回復をＩＰ／ＩＣＭＰ層に通知し、廃棄されたＩＰパケットをＳｏｕｒｃｅ　Ｑｕｅｎｃｈパケットに付加して送信元のエンドシステムに通知した後に中継するＩＰパケットに転送優先度に応じた廃棄優先度を割り当て、割り当てられた廃棄優先度をデータリンク層以下のプロトコルヘッダの廃棄優先度パラメタにマッピングするようにしたことにより、網輻輳、特にフレームリレー網やＡＴＭ網の輻輳に対してトラヒック特性に応じたデータの転送優先度に基づき送信制御を行うことが可能となるという効果がある。

【００５５】このようにして、ＩＰルータあるいは網での輻輳による、上位アプリケーションへの影響を少なくすることが可能となる。さらに、複数のトラヒック特性が混在しているマルチメディア情報の円滑な通信を実現することが可能となる。

【図面の簡単な説明】

【図１】本発明の一実施例に係る優先制御方式の構成を示すブロック図である。

【図２】本実施例の優先制御方式が含まれるネットワークの概念図である。

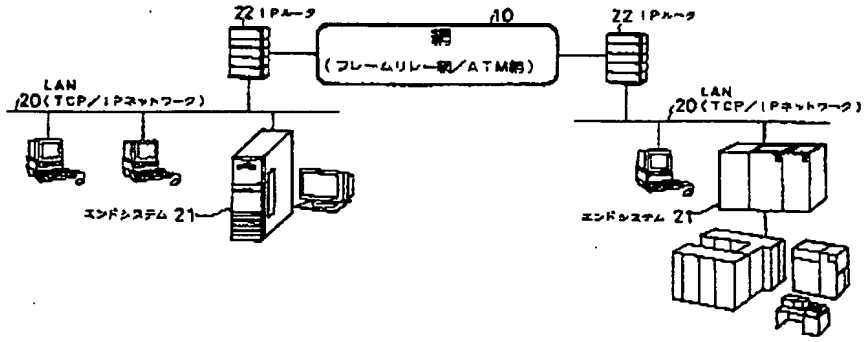
【図３】図１中のエンドシステムにおける制御フローチャートであり、（ａ）はデータ送信時の処理、（ｂ）はＳｏｕｒｃｅ　Ｑｕｅｎｃｈパケット受信時の処理をそれぞれ示す。

【図４】図１中のＩＰルータにおける制御フローチャートであり、（ａ）はＩＰルータ内輻輳発生時の処理、（ｂ）は網輻輳発生時の処理をそれぞれ示す。

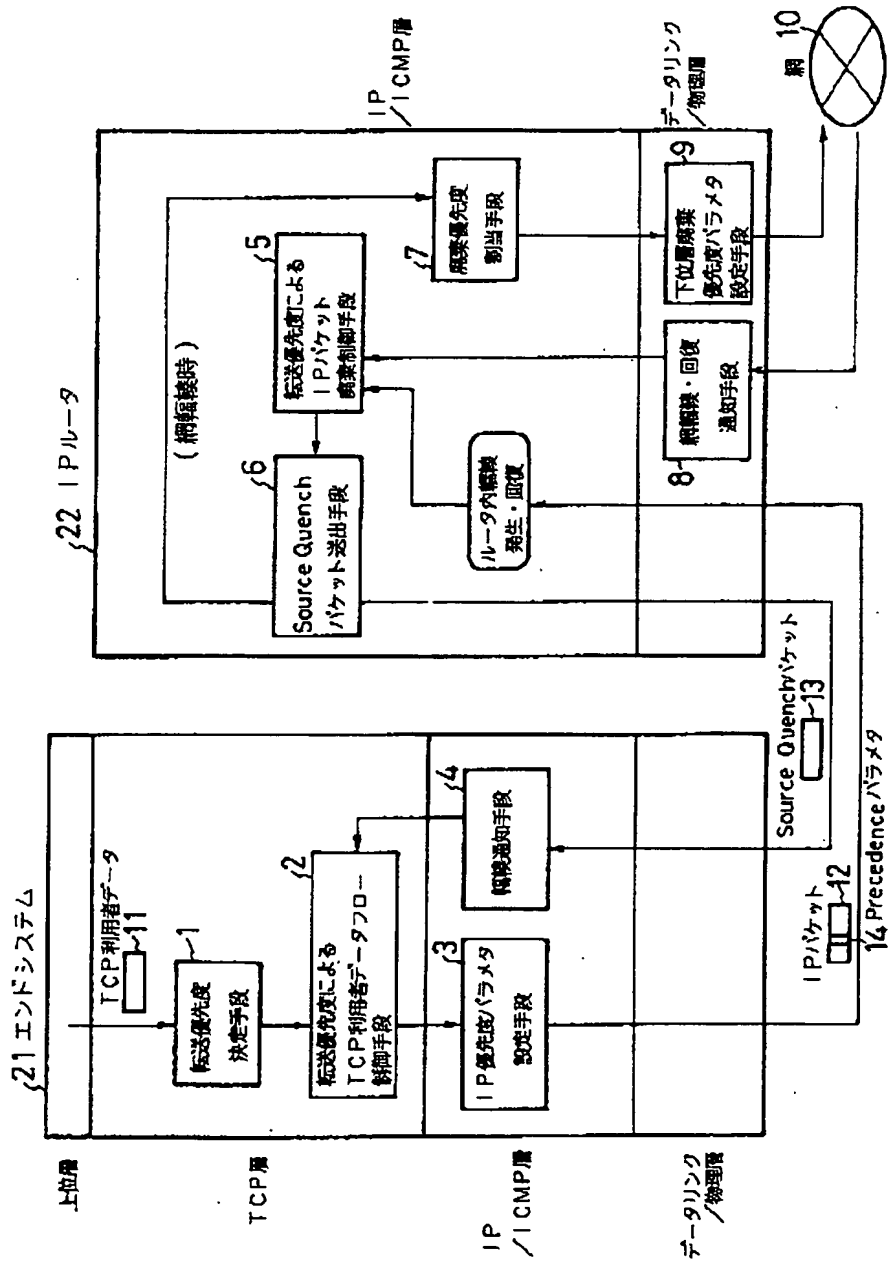
【符号の説明】

１　転送優先度決定手段
２　転送優先度によるＴＣＰ利用者データフロー制御手段
３　ＩＰ優先度パラメタ設定手段
４　輻輳通知手段
５　転送優先度によるＩＰパケット廃棄制御手段
６　Ｓｏｕｒｃｅ　Ｑｕｅｎｃｈパケット送出手段
７　廃棄優先度割当手段
８　網輻輳・回復通知手段
９　下位層廃棄優先度パラメタ設定手段
１０　網（フレームリレー網／ＡＴＭ網）
１１　ＴＣＰ利用者データ
１２　ＩＰパケット
１３　Ｓｏｕｒｃｅ　Ｑｕｅｎｃｈパケット
１４　Ｐｒｅｃｅｄｅｎｃｅパラメタ
２０　ＬＡＮ（ＴＣＰ／ＩＰネットワーク）
２１　エンドシステム
２２　ＩＰルータ

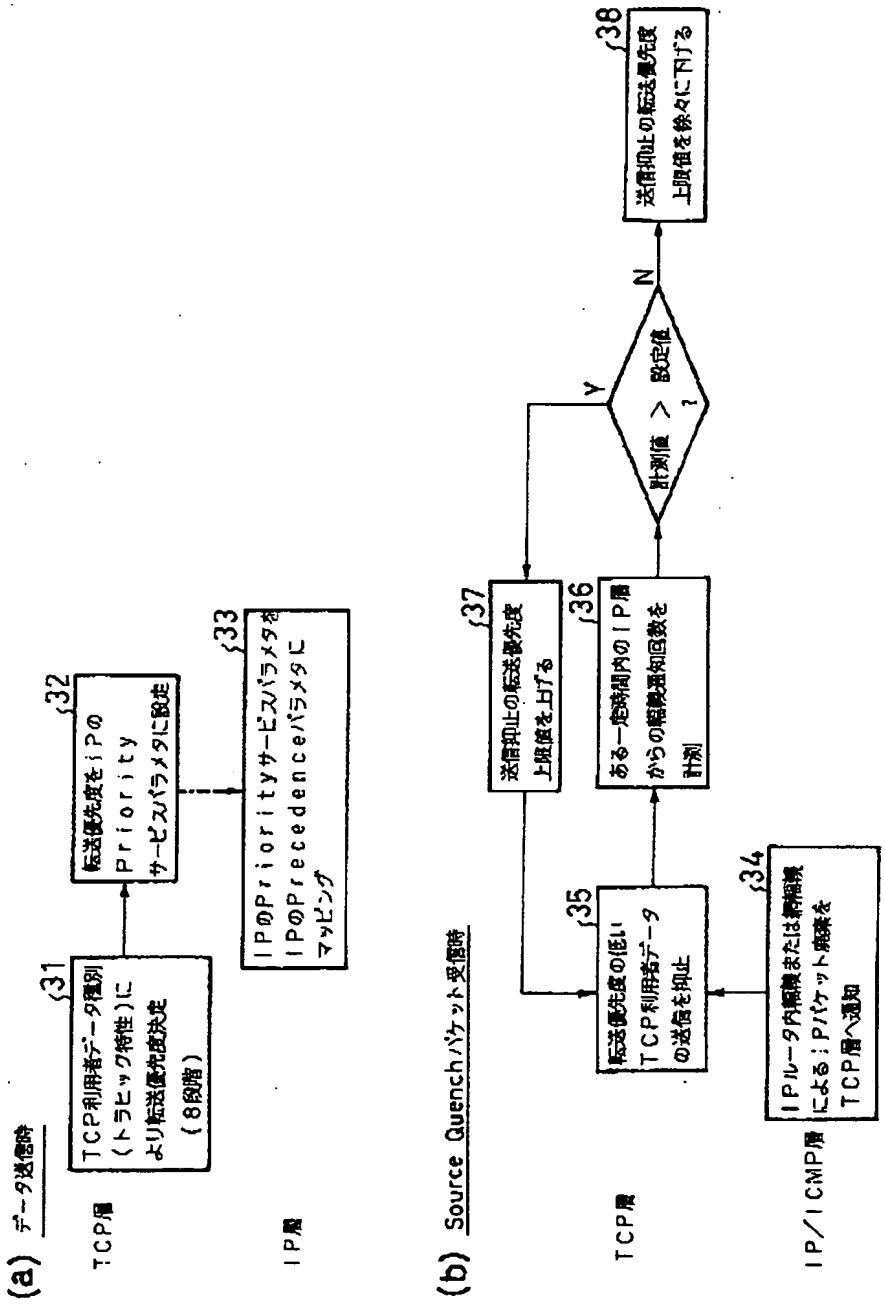
【図２】



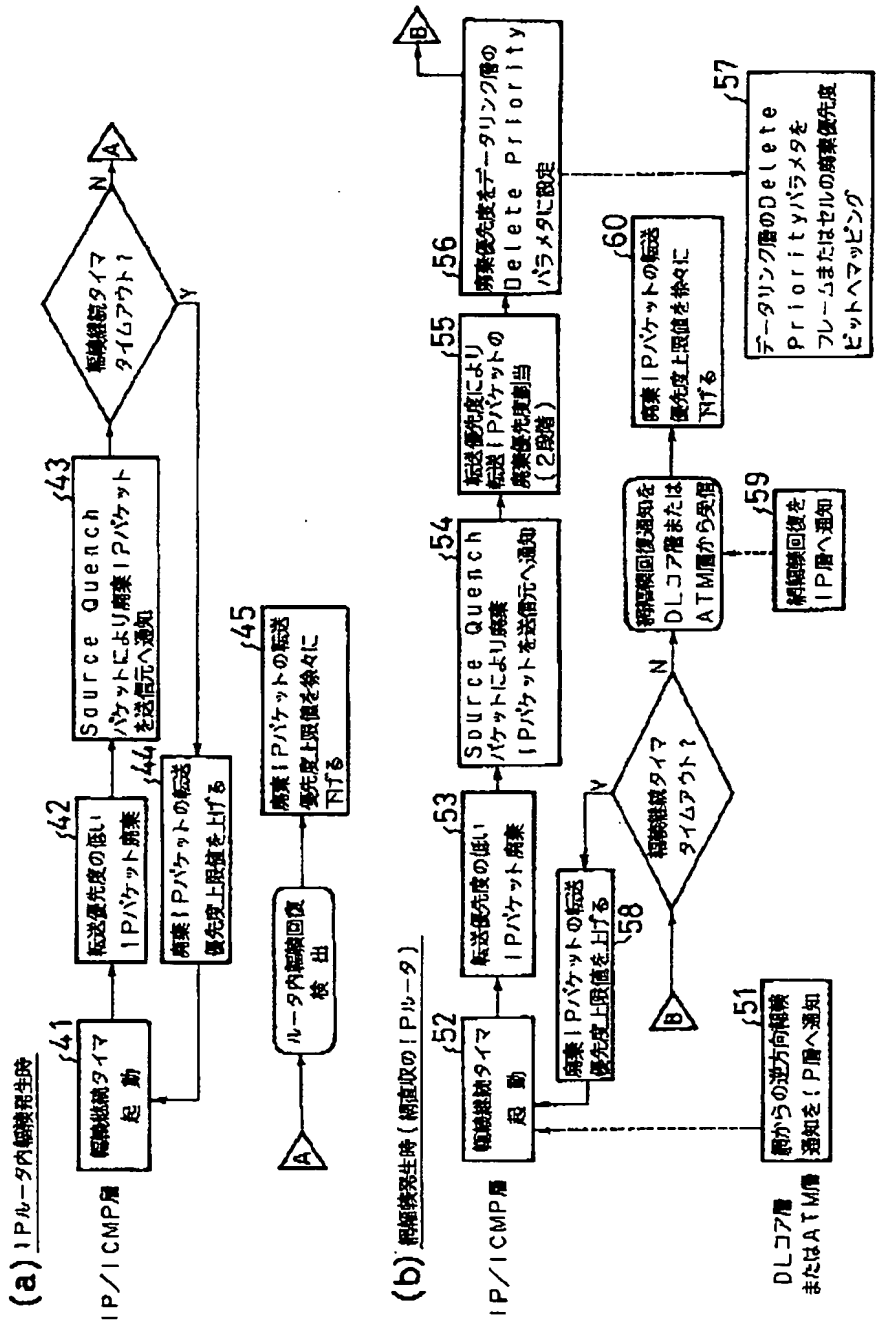
【図1】


網 10
IP /ICMP層
データリンク /物理層
22 IPルータ
(網輻輳時)
Source Quench パケット送出手段
6
転送優先度による IPパケット廃棄制御手段
5
廃棄優先度 割当手段
7
ルータ内輻輳 発生・回復
網輻輳・回復 通知手段
8
下位層廃棄 優先度パラメタ 設定手段
9
21 エンドシステム
TCP利用者データ
11
転送優先度 決定手段
1
転送優先度による TCP利用者データフロー 制御手段
2
IP優先度パラメタ 設定手段
3
輻輳通知手段
4
Source Quenchパケット
13
IPパケット
12
14 Precedenceパラメタ
上位層
TCP層
IP /ICMP層
データリンク /物理層

【図3】


(a) データ送信時
TCP層
IP層
TCP利用者データ種別(トラヒック特性)により転送優先度決定(8段階)
31
転送優先度をIPのPriorityサービスパラメタに設定
32
IPのPriorityサービスパラメタをIPのPrecedenceパラメタにマッピング
33
(b) Source Quenchパケット受信時
TCP層
IP/ICMP層
IPルータ内輻輳または前輻輳によるICMPパケット廃棄をTCP層へ通知
34
転送優先度の低いTCP利用者データの送信を抑止
35
ある一定時間内のIP層からの輻輳通知回数を計測
36
送信抑止の転送優先度上限値を上げる
37
計測値 > 設定値
Y
N
送信抑止の転送優先度上限値を徐々に下げる
38

【図4】


(a) IPルータ内輻輳発生時
IP/ICMP層
輻輳継続タイマ起動
転送優先度の低いIPパケット廃棄
廃棄IPパケットの転送優先度上限値を上げる
Source Quenchパケットにより廃棄IPパケットを送信元へ通知
輻輳継続タイマタイムアウト?
N
Y
ルータ内輻輳回復検出
廃棄IPパケットの転送優先度上限値を下げる
(b) 輻輳状況生時(輻湊改のIPルータ)
IP/ICMP層
輻輳継続タイマ起動
転送優先度の低いIPパケット廃棄
Source Quenchパケットにより廃棄IPパケットを送信元へ通知
転送優先度により転送IPパケットの廃棄優先度割当(2段階)
廃棄優先度をデータリンク層のDelete Priorityパラメタに設定
廃棄IPパケットの転送優先度上限値を下げる
輻輳継続タイマタイムアウト?
N
輻輳回復通知をDLコア層またはATM層から受信
輻輳回復をIP層へ通知
廃棄IPパケットの転送優先度上限値を上げる
データリンク層のDelete Priorityパラメタをフレームまたはセルの廃棄優先度ビットへマッピング
DLコア層またはATM層
網からの逆方向輻輳通知をIP層へ通知